EP 312938

PCT

WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 5 : F01L 1/22 — A1

(11) International Publication Number: WO 90/10787

(43) International Publication Date: 20 September 1990 (20.09.90)

(21) International Application Number: PCT/GB90/00294

(22) International Filing Date: 26 February 1990 (26.02.90)

(30) Priority data:
8905591.7 10 March 1989 (10.03.89) GB

(71) Applicant *(for all designated States except US)*: GKN TECHNOLOGY LIMITED [GB/GB]; Birmingham New Road, Wolverhampton, West Midlands WV4 6BW (GB).

(72) Inventor; and

(75) Inventor/Applicant *(for US only)* : McROBERT, Stewart, Clark [GB/GB]; 134 Thornhill Road, Streetly, Sutton Coldfield, West Midlands B74 2ED (GB).

(74) Agents: THORPE, Brian et al.; GKN plc, Group Patents & Licensing Dept., P.O. Box 55, Ipsley House, Ipsley Church Lane, Redditch, Worcestershire B98 OTL (GB).

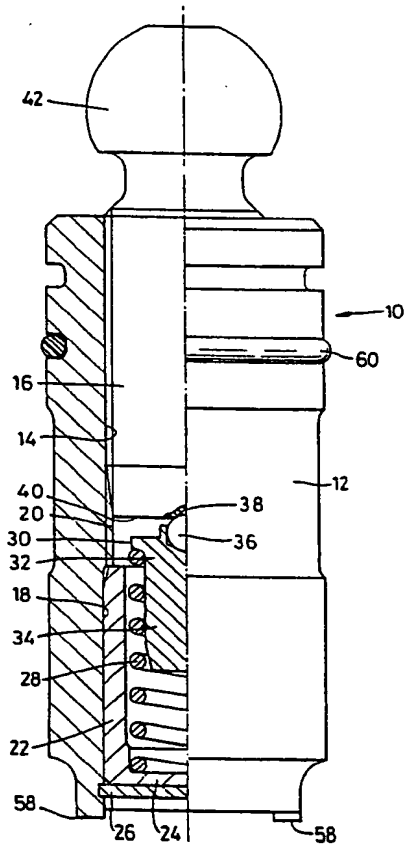
(81) Designated States: AT (European patent), BE (European patent), CH (European patent), DE (European patent), DK (European patent), ES (European patent), FR (European patent), GB, GB (European patent), IT (European patent), JP, LU (European patent), NL (European patent), SE (European patent), US.

Published
With international search report.

(54) Title: AUTOMATIC LENGTH ADJUSTER

(57) Abstract

A mechanical automatic length adjuster comprises a screw (16) of generally buttress thread form running within an internally threaded housing (12) on running flanks under the action of a coil compression spring (28) within the housing. The housing is provided with a through bore having an unthreaded bore portion (18) at one end within which is retained a cup member (22) providing a reaction surface for the spring; the cup member being retained by a circlip (26) at the end of the unthreaded bore portion. A bearing member (32) is provided between the other end of the spring and the inner end of the screw which extends into the housing and includes a guide portion (34) extending into the spring convolutions and a captive ball bearing (36) providing low friction engagement with the inner end of the screw.



FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AT	Austria	ES	Spain	MG	Madagascar
AU	Australia	FI	Finland	ML	Mali
BB	Barbados	FR	France	MR	Mauritania
BE	Belgium	GA	Gabon	MW	Malawi
BF	Burkina Fasso	GB	United Kingdom	NL	Netherlands
BG	Bulgaria	HU	Hungary	NO	Norway
BJ	Benin	IT	Italy	RO	Romania
BR	Brazil	JP	Japan	SD	Sudan
CA	Canada	KP	Democratic People's Republic of Korea	SE	Sweden
CF	Central African Republic			SN	Senegal
CG	Congo	KR	Republic of Korea	SU	Soviet Union
CH	Switzerland	LI	Liechtenstein	TD	Chad
CM	Cameroon	LK	Sri Lanka	TG	Togo
DE	Germany, Federal Republic of	LU	Luxembourg	US	United States of America
DK	Denmark	MC	Monaco		

AUTOMATIC LENGTH ADJUSTER

This invention relates to a mechanical automatic length adjuster comprising an internally screw-threaded housing, an externally threaded screw extending within the housing and spring means acting axially on the screw to cause it to rotate and advance outwardly of an open end of the housing to lengthen the adjuster; the co-operating thread forms of the screw and the housing being so configured that the screw will rotate freely and advance out of the housing on co-operating running flanks of the threads under the axial spring bias.

One form of such a length adjuster is described in GB-A-2160945, the adjuster comprising a self-contained device preferably for use as an automatic clearance adjuster in a valve train mechanism of an internal combustion engine or, alternatively, for use as a self-levelling device or as a belt tensioner. Another form of such a length adjuster is described in GB-A-2033472 wherein the housing is incorporated as an integral part of a rocker arm, or the screw is incorporated as an integral part of a valve stem, for automatic clearance adjustment in a valve train mechanism of an internal combustion engine.

In both of the aforesaid patent specifications embodiments of the housing are illustrated as having a through bore. It is preferred to utilise a housing with a through bore whereby the formation of the internal thread form, as by tapping, is facilitated but the housing must then be provided with a closure member at one end of the bore to provide a reaction surface for the spring means. For example, in GB-A-2160945 a closure member is provided in the form of a cap screw threaded

into the end of the bore.

It is an object of the present invention to provide an improved construction of mechanical automatic length adjuster.

In accordance with the invention there is provided a mechanical automatic length adjuster comprising an internally threaded housing, a screw member within said housing having an external thread form configured to run within the thread form of the housing, the thread forms exhibiting a relatively high friction in one direction of axial loading of the screw threads compared with a relatively low friction in the opposite direction of axial loading, spring means acting on the screw member to bias it in the said opposite direction of axial loading and thus to urge the screw member in a direction to advance axially of the housing with the thread form being configured to provide co-operating running flanks and locking flanks whereby the screw member will rotate and advance axially of the housing when the axial thrust of the spring means urges said running flanks together characterised in that the housing is provided with a through bore having a said thread form extending from one open end of the housing axially of the bore and an unthreaded bore portion extending from the end of the said thread form to the other open end of the housing; a cup member being received within said unthreaded bore portion, the spring means acting between a base of said cup member and the screw member, and means retaining said cup member within said unthreaded bore portion.

Said cup member may be received loosely within said unthreaded bore portion of the housing, or may be an

interference fit therein, or may be secured therein by an adhesive.

Said cup member may be of generally cylindrical form having a said base located adjacent said other open end of the housing and a generally cylindrical hollow body engaged within said unthreaded bore portion of the housing. Said retaining means conveniently comprises a clip member engaged with said housing at or adjacent its said other open end and providing an abutment for the said base of the cup member. The clip member may comprise a spring clip engaged within an annular recess in the unthreaded bore portion of the housing providing a radially inwardly extending abutment for the base of the cup member.

A bearing member may be provided between that end of the spring means remote from the cup member base and an inner end of the screw member which extends into the housing, the spring means acting upon an abutment on said bearing member to transmit the axial thrust of the spring means to the screw member through the bearing member. The bearing member preferably includes said abutment thereon and a ball bearing element bearing upon said inner end of the screw member. The spring means is conveniently in the form of a coil compression spring and the bearing member conveniently further includes a guide portion extending axially inwardly of the spring convolutions.

The surfaces of the said locking flanks of the screw member and of the housing as seen in axial cross-section may be so configured as to be incapable of contiguous mating engagement with one another. The locking flank of the housing may comprise a continuous surface as seen in

axial cross-section and the locking flank of the screw member may comprise a discontinuous surface as seen in axial cross-section being limited to a width less than the width of the engaging locking flank of the housing and comprising a plurality of helically extending lands and grooves.

Other features of the invention will become apparent from the following description given herein solely by way of example with reference to the accompanying drawings wherein:-

Figure 1 is a part elevation, part cross-sectional view of a mechanical automatic length adjuster constructed in accordance with the invention; and

Figure 2 is a diagrammatic view of one embodiment of the adjuster of Figure 1 incorporated as a clearance adjuster in a valve train mechanism of an internal combustion engine.

Referring to Figure 1 of the drawings there is shown a self contained mechanical automatic length adjuster which, for example, may be utilised as an automatic clearance adjuster in the valve train mechanism of an internal combustion engine as illustrated diagrammatically in Figure 2. It should however be appreciated that the adjuster may be advantageously utilised in other applications such as, for example, as a belt tensioner, a brake adjuster or as a self-levelling device or in any other convenient application.

The adjuster 10 illustrated in Figure 1 comprises a steel housing 12 of generally cylindrical configuration with a central axial through bore which is tapped for a

distance extending somewhat in excess of half of the axial length of the bore to provide an internal screw thread 14 of buttress thread form. A solid steel screw 16 also of generally cylindrical form has an external screw thread rolled or cut thereon of a buttress thread form complementary to the internal buttress thread form of the housing. Such co-operating buttress thread forms provide co-operating running flanks and locking flanks thereon and are conveniently formed to the same geometrical criteria as described in GB-A-2160945, the disclosure of which is hereby incorporated by reference.

An unthreaded bore portion 18 extends substantially from the end of the thread form 14 to the other open end of the housing although the diameter of said unthreaded bore portion 18 is slightly in excess of the diameter of a shoulder portion 20 of the bore located intermediate the threaded and unthreaded bore portions. A cup member 22 of hollow generally cylindrical form is received within the unthreaded bore portion 18 and is restrained against axial movement inwardly of the bore by abutment of the open end of the cup member against the shoulder portion 20. The cup member 22 is provided with a planar base portion 24 and is restrained against movement axially out of the bore by a spring clip 26 engaged within an annular recess formed in the housing adjacent the end of the bore, the spring clip providing a radially inwardly extending abutment for the base of the cup member.

A coil compression spring 28 is located within the cup member 22 to bear at one end on the base 24 thereof and at the other end upon an annular shoulder 30 provided on a bearing member 32 having a cylindrical guide portion 34 which extends within the spring convolutions. That

end of the bearing member 32 remote from the spring is provided with a captive ball bearing 36 for low-friction bearing engagement within a co-operating recess 38 formed centrally in the planar inner end surface 40 of the screw 16.

The open end of the cup member 22 is provided with an externally tapered wall adjacent its periphery facilitating its insertion into the unthreaded bore portion 18 through the open end thereof whereas the internal wall surface of the cup member is also tapered at its open end to prevent inadvertent catching of the compression spring 28 thereon.

As illustrated, the axially outer end of the screw 16 is provided with a domed head 42 although the specific configuration of this outer end of the screw is not relevant to the present invention. Thus, under the action of the coil compression spring 28, the screw 16 is urged axially outwardly of the housing 12 and will rotate freely and advance out of the housing on the co-operating running flanks of the buttress thread forms solely under the axial spring bias of the compression spring 28. The screw 16 will rotate freely upon the low friction contact surface between the ball bearing 36 and the recess 38 in the screw inner end. Conversely, the screw 16 will be prevented from rotation by co-operation between the locking flanks of the buttress thread forms upon application of axial forces to the screw in a direction against the direction of the spring bias; a preferred configuration of the thread form is shown in Figure 2.

It will be appreciated that the thrust of the spring 28 is transmitted to the screw 16 through the intermediary of the bearing member 32 and the ball

bearing 36, and that the ball bearing provides the only point of contact with the screw. Thus, although the ball bearing 36 and at least the recess 38 of the screw 16 require to be of a hardened material, there is no requirement for the housing 12 or the cup member 22 to be hardened.

That end of the housing 12 adjacent the spring clip 26 is provided with a plurality of axially outwardly projecting wedge shaped lugs 58 with the apex of each lug extending generally radially of the housing. The purpose of these lugs 58 is described below with reference to Figure 2.

Referring to Figure 2 of the drawings the adjuster 10 of the invention is shown diagrammatically as being incorporated in an internal combustion engine valve train mechanism comprising a cam 44, an end-pivot type of rocker arm 46 and the said adjuster 10. In accordance with known practice, the rocker arm 46 has an upper surface curved slipper portion 48 upon which the cam 44 acts, a lower surface abutment portion 50 at one end of the rocker arm for acting on a valve stem (not shown) and a lower surface hemispherical recess 52 at the other end of the rocker arm which comprises a fulcrum point for the arm and which receives the domed head 42 of the screw 16.

In use of the adjuster as described above, the housing 12 is located within a socket in the cylinder head of the engine and must be retained therein against any rotation relative to the socket. Such rotation is prevented by the wedge shaped lugs 58 on the housing 12 which, under the axial forces applied to the adjuster, establish a "grip" of the lugs 58 with the base of the said socket. Any tendency of the housing 12 to rotate

within the socket is further resisted by the provision of an elastomeric O-ring 60 on the housing which engages with an interference fit in the socket when the adjuster is located therein.

As shown in Figure 2, the locking flanks 54 and 56 of the co-operating buttress threads of the screw and the housing respectively are so configured to be incapable of establishing contiguous mating engagement with one another. In the embodiment illustrated the locking flank 54 of the screw is helically grooved thereby effectively reducing the width of the screw member locking flank i.e. the locking flank width becomes equivalent to the surface width of each land between each pair of adjacent grooves. By providing several such lands e.g. four per locking flank, the wear rate in the adjuster is reduced.

The reduction of locking flank contact area between the screw and the housing enables the said lands in the locking position to effectively break through the oil film lubrication which is present in use and to establish the desired high friction condition leading to locking and prevention of an undesirable degree of back-off rotation. Also, the overall width of the locking flank of the screw is less than the width of the locking flank of the housing providing a helical oil reservoir between the screw and the housing. This helical reservoir enhances the flow of lubricating oil to the running flanks of the screw and housing and also provides a helical pressure relief path for the oil.

CLAIMS

1. A mechanical automatic length adjuster comprising an internally threaded housing(12), a screw member(16) within said housing having an external thread form configured to run within the thread form of the housing, the thread forms exhibiting a relatively high friction in one direction of axial loading of the screw threads compared with a relatively low friction in the opposite direction of axial loading, spring means(28) acting on the screw member to bias it in the said opposite direction of axial loading and thus to urge the screw member in a direction to advance axially of the housing with the thread form being configured to provide co-operating running flanks and locking flanks whereby the screw member will rotate and advance axially of the housing when the axial thrust of the spring means urges said running flanks together characterised in that the housing(12) is provided with a through bore having a said thread form(14) extending from one open end of the housing axially of the bore and an unthreaded bore portion(18) extending from the end of the said thread form to the other open end of the housing; a cup member(22) being received within said unthreaded bore portion, the spring means(28) acting between a base(24) of said cup member and the screw member(16), and means(26) retaining said cup member within said unthreaded bore portion.

2. A mechanical automatic length adjuster as claimed in Claim 1 further characterised in that said cup member(22) is of generally cylindrical form having a said base(24) located adjacent said other open end of the housing and a generally cylindrical hollow body engaged within said unthreaded bore portion(18) of the housing.

3. A mechanical automatic length adjuster as claimed in either one of Claims 1 or 2 further characterised in that said retaining means comprises a clip member(26) engaged with said housing at or adjacent its said other open end and providing an abutment for the said base(24) of the cup member.

4. A mechanical automatic length adjuster as claimed in Claim 3 further characterised in that said clip member comprises a spring clip(26) engaged within an annular recess in the unthreaded bore portion(18) of the housing providing a radially inwardly extending abutment for the base of the cup member.

5. A mechanical automatic length adjuster as claimed in any one of the preceding claims further characterised in that a bearing member(32) is provided between that end of the spring means remote from the cup member base and an inner end(40) of the screw member which extends into the housing, the spring means(28) acting upon an abutment(30) on said bearing member to transmit the axial thrust of the spring means to the screw member through the bearing member.

6. A mechanical automatic length adjuster as claimed in Claim 5 further characterised in that said bearing member(32) includes said abutment(30) thereon and a ball bearing element(36) bearing upon said inner end(40) of the screw member.

7. A mechanical automatic length adjuster as claimed in either one of Claims 5 or 6 further characterised in that the spring means comprises a coil compression spring(28) and the bearing member(32) further includes a guide

portion(34) extending axially inwardly of the spring convolutions.

8. A mechanical automatic length adjuster as claimed in any one of the preceding claims further characterised in that that end of the housing adjacent the said unthreaded bore portion(18) is provided with a plurality of axially extending lugs(58) for engagement with the base of a socket within which the housing is locatable.

9. A mechanical automatic length adjuster as claimed in any one of the preceding claims further characterised in that the surfaces of the said locking flanks(54, 56) of the screw member and of the housing as seen in axial cross-section are so configured as to be incapable of contiguous mating engagement with one another.

10. A mechanical automatic length adjuster as claimed in Claim 9 further characterised in that the locking flank(56) of the housing comprises a continuous surface as seen in axial cross-section and the locking flank(54) of the screw member comprises a discontinuous surface as seen in axial cross-section.

11. A mechanical automatic length adjuster as claimed in Claim 10 further characterised in that the said discontinuous surface of the locking flank(54) of the screw member is limited to a width less than the width of the engaging locking flank(56) of the housing and comprises a plurality of helically extending lands and grooves.

12. A mechanical automatic length adjuster as claimed in any one of the preceding claims further characterised in that it is constructed and arranged as a self-contained mechanism.

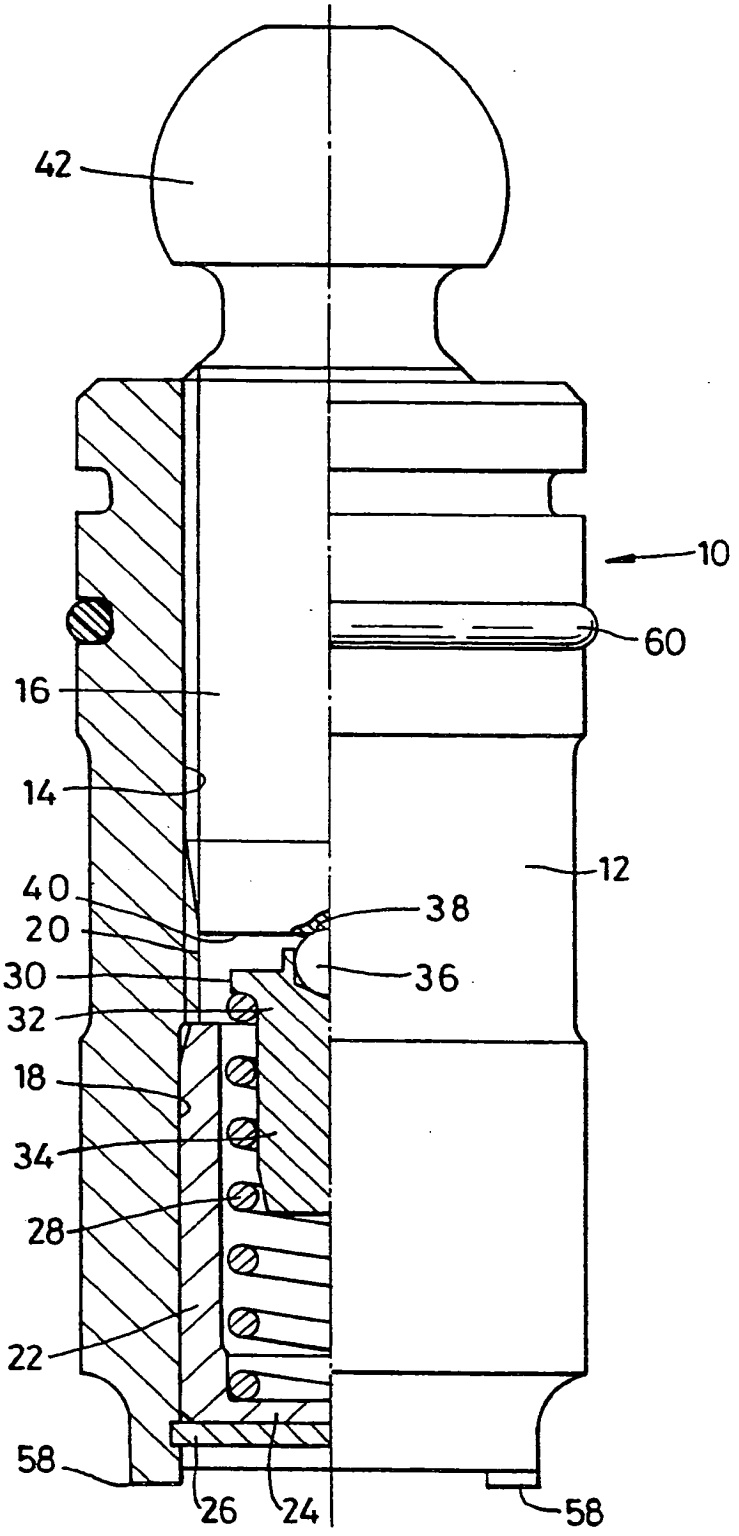


Fig. 1

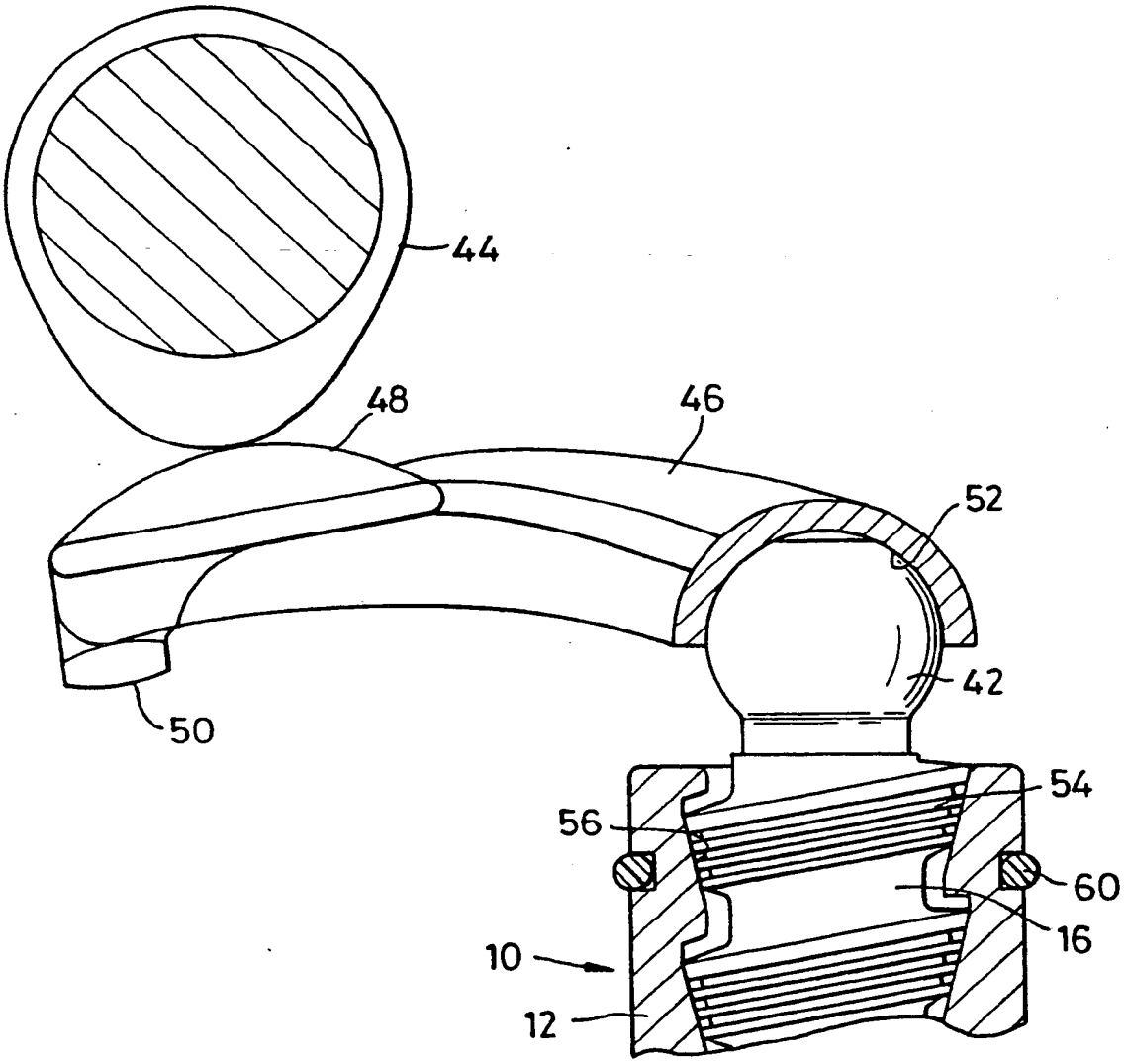


Fig. 2

INTERNATIONAL SEARCH REPORT

International Application No PCT/GB 90/00294

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all)[7]

According to International Patent Classification (IPC) or to both National Classification and IPC

IPC5: F 01 L 1/22

II. FIELDS SEARCHED

Minimum Documentation Searched[8]

Classification System	Classification Symbols
IPC5	F 01 L; F 02 B

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in Fields Searched[8]

III. DOCUMENTS CONSIDERED TO BE RELEVANT[9]

Category *	Citation of Document,[11] with indication, where appropriate, of the relevant passages[12]	Relevant to Claim No.[13]
A	GB, A, 2160945 (GKN TECHNOLOGY LIMITED) 2 January 1986, see the whole document	1-12
A	GB, A, 2033472 (GKN FASTENERS LIMITED) 21 May 1980, see the whole document	1-12
E	GB, A, 2211263 (GKN TECHNOLOGY LIMITED) 28 June 1989, see the whole document	1-12

* Special categories of cited documents:[10]

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance, the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

"Y" document of particular relevance, the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
9th May 1990	31. 05. 90
International Searching Authority	**Signature of Authorized Officer**
EUROPEAN PATENT OFFICE	F.W. HECK

Form PCT/ISA/210 (second sheet) (January 1985)

III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)

Category *	Citation of Document, with indication, where appropriate, of the relevant passages	Relevant to Claim No
E	WO, A1, 89/05898 (GKN TECHNOLOGY LIMITED) 29 June 1989, see the whole document	1-12

--

ANNEX TO THE INTERNATIONAL SEARCH REPORT ON INTERNATIONAL PATENT APPLICATION NO. PCT/GB 90/00294

SA 34733

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report.
The members are as contained in the European Patent Office EDP file on 30/03/90
The European Patent office is in no way liable for theseparticulars which are merely given for the purpose of information.

Patent document cited in search report	Publication date	Patent family member(s)		Publication date
GB-A- 2160945	02/01/86	AU-B-	573359	02/06/88
		AU-D-	4493985	24/01/86
		EP-A-	0213138	11/03/87
		JP-T-	61502553	06/11/86
		US-A-	4706620	17/11/87
		WO-A-	86/00372	16/01/86
GB-A- 2033472	21/05/80	NONE		
GB-A- 2211263	28/06/89	WO-A-	89/05898	29/06/89
WO-A1- 89/05898	29/06/89	NONE		

For more details about this annex : see Official Journal of the European patent Office, No. 12/82

EPO FORM P0479